RIVERINE RIPARIAN CORRIDOR MAINTENANCE NEEDS ASSESSMENT

The seasonal instream flow regime for maintaining the Sheyenne River riparian corridor and the Red River of the North riparian corridor was developed by first evaluating the relationships between streamflow and riparian water table elevations along these rivers. The relationships between existing streamflow and riparian water table elevations along both rivers were evaluated using methodology developed for the San Pedro River, Arizona, study (Jackson et al. 1987). Secondly, the seasonal instream flow regime for aquatic life maintenance was reviewed and items were added which would maintain the existing long-term river-specific riparian corridors. Maintenance of the existing forest community was assumed to be applicable to all associated vegetational communities to include associated wetlands along the Sheyenne River and the Red River of the North.

The natural values of the Sheyenne River and Red River of the North are inextricably linked to water resources. Riparian vegetation, wildlife, fisheries, recreation, and other water-related natural values depend on instream flows (including floods and related groundwater conditions). Baseflows and riparian zone water tables are maintained almost entirely by surface water inflows except for the Sheyenne River reach between Lisbon, North Dakota, and the Kindred, North Dakota, area. This stream reach is a gaining reach. It receives inflows from groundwater from the Sheyenne aquifer. Between Lake Ashtabula (Baldhill Dam) near Valley City, North Dakota, and the Fargo, North Dakota, area, riverflow is maintained by both surface runoff and flow releases from Baldhill Dam. Depending on where you are on the river system, regional groundwater depletions or localized (near stream) drawdowns in the flood plain aquifer can reduce instream flows and concurrently lower riparian zone water tables. The existing woody riparian community (oak-elm-ash complex) along the Sheyenne River and Red River of the North is somewhat sensitive to water table declines. Periodic floodflows are required for vegetation reproduction, flood plain development, and channel maintenance and evolution.

The viability of any mechanism (legal, administrative, or technical) which serves to protect the water-dependent natural resources of the Sheyenne River and the Red River of the North needs to rely on a thorough scientific analysis of the relationships between natural characteristics of the area and water availability.

Riparian Vegetation

The riparian corridor is dominated by a variety of trees. These include bur oak, hackberry, box elder, American elm, basswood, and green ash with occasional peachleaf willow along the riverbanks. Ordinarily a well developed understory, usually present, is composed of small trees and tall shrubs including hop-hornbeam and prickly ash. All of the these species are tolerant or very tolerant to flooding. The herbaceous vegetation of the riparian floor is especially luxuriant and is composed of a variety of species. The more common plants are nodding fescue, Virginia wild rye, nodding muhly, charming sedge, Sprengel's sedge, jack-in-the-pulpit, wood leek, large bellwort, false Soloman's seal, Soloman's seal, nodding trillium, carrion flower, wood nettle,

wild ginger, columbine, kidneyleaf buttercup, tall meadowrue, bloodroot, yellow wood violet, pink wood violet, wild sarsaparilla, honewort, and waterleaf (Stewart 1975 and field data collections). As for the forest community, these herbaceous species are all tolerant to flooding and moist soil conditions.

The oak-elm-ash complex provides the primary structure of the riparian gallery forest. Pioneer species such as peachtree willow establish a foothold for other species to begin the stream terrace building process. These pioneer species are confined to very shallow groundwater sites and require sustained flow for seedling establishment. Oak-elm-ash colonization occurs after pioneer species establishment. Seed drop and moderately high streamflows must coincide for oak-elm-ash reproduction. Seedlings require moist sites such as streambanks and overflow channels. Moist soil conditions must prevail until roots grow to depths where moisture is continuously available (roughly the water table). The oak-elm-ash complex draws its water from the immediate stream recharge zone/shallow stream aquifer. Therefore, maintaining the stream recharge zone/shallow stream aquifer is very important. Moist soil conditions will maintain the herbaceous vegetation of the riparian floor. Most of the existing riparian species will also tolerate moderate drought conditions.

On both the Sheyenne River and Red River of the North flood plains, three forest types can be distinguished. On the lowest and most frequently flooded area, pioneering tree species such as peachtree willow and cottonwood are very sparse. More mature cottonwoods are sparsely scattered throughout the flood plain. The forest community consists of older cottonwoods, bur oak, box elder, and green ash. At the highest elevations, flood plain forests are dominated by green ash, box elder, American elm, and bur oak. Canopies are relatively closed and lack the tall shrub and sapling layer characteristic of cottonwood forests.

Both the Sheyenne River and Red River of the North no longer contain many stream bars, abandoned meanders, or many areas where overflow flooding occurs. Peachtree willow and cottonwood colonization is absent on most stream bars and streambanks (e.g., overflow channels or abandoned meanders). In the absence of rejuvenation by flooding, cottonwoods and peachtree willows have and will continue to disappear since seedbed requirements for regeneration appear to be lacking and/or overflow flooding occurs at the wrong time of the year (not corresponding to seed drop). Aggradation of alluvium subsequent to bar building during flooding requires that root depth accommodate depth of aggradation for roots to obtain moist soil near the groundwater or for tap roots to tap the groundwater. Sediment aggradation must continue to provide a seedbed for cottonwoods and willows. The rate of river stage drawdown has most recently occurred abruptly instead of gradually, and has negatively affected seedling survival rates. Rainfall alone is usually not sufficient to support seed germination and reestablishment of pioneering species on alluvial bars (Segelquist et al. 1993). Lack of pioneering species rejuvenations has changed the plant dominance from a cottonwood-willow complex in the lower flood plain to higher species diversity but lower landscape diversity.

Evaluation of Streamflow and Riparian Water Table Elevations

The relationships between existing streamflow and riparian water table elevations along both rivers were evaluated using methodology developed for the San Pedro River, Arizona, study (Jackson et al. 1987). Baseflows and riparian zone water tables are maintained almost entirely by inflows from the regional groundwater aquifer. Riparian stands along both rivers are therefore sensitive to water table fluctuations.

Annual flows during both the high (March-June) and low flow (July-February) periods of record have increased within the last 10 years of historical record (the historical record used for this study - 1931-1984; see Appendix B - Tables B-2). Groundwater well levels have remained fairly constant over time. There does not appear to be an indication that groundwater levels in the flood plain aquifer have or are declining with the existing hydrograph.

Riparian Corridor Flow Analysis

The annual flow regime for both the Sheyenne River and the Red River of the North was stratified into two distinct seasons to facilitate the riverine corridor flow analyses (same seasonal distribution as used for the aquatic life maintenance flow analyses) - spawning period, March-June (high flow), and maintenance period, July-February (low flow).

High Flow Period (March-June)

Annual flows during the high flow period have actually increased within the last 10 years of record (the historical record used for this study - 1931-1984; see Appendix B - Tables B-2). These flows normally would beneficially influence riparian vegetation seedling establishment by increasing the availability of required continuously moist surface soil conditions, however, it appears that the flows do not correspond to pioneering species seed drop (late May-early July). Large overbank flows usually occur during March and early April. This period is also a critical period for fish spawning and juvenile fish survival and growth, and is an important bird migration period. It is also an important recreational use period on both rivers. Flows are also required to prevent further loss of open water habitat for fish and wildlife.

Managing the rivers to meet the aquatic life maintenance seasonal instream flow regime would maintain a perennial stream throughout each representative river reach, however, the magnitude of the flows would be less than the mean seasonal flows of record (approximately one-half the magnitude of the historic flows - see Table 3, Table 6-10, and Table 11). The existing hydrograph would be somewhat flattened. It is expected, however, that managing the rivers to meet the aquatic life maintenance seasonal instream flow regime should stabilize groundwater levels at their present levels, and, at the same time, provide adequate moist soil conditions for the riparian forest community. The aquatic life maintenance seasonal instream flow regime is anticipated to maintain the existing flood plain forest community in its present status.

Table 11
Sheyenne River and Red River of the North
Seasonal Instream Flow Regime for Riverine Riparian Corridor Maintenance and Improvement

	Mean Seasonal Flows[1] and Seasonal Spawning Flows[2] March-June (cfs)		Mean Seasonal Flows[1] and Seasonal Maintenance Flows[2] July-February (cfs)		Maximum Out-of-Channel Flows[3] Late May-Early July (cfs)
Sheyenne River					
Harvey, ND (05054500)[4]	21[1]	25[2]	2[1]	15[2]	None
Warwick, ND (05056000)	124	100	11	25	<600
Cooperstown, ND (05057000)	226	125	22	50	<800
Baldhill Dam, ND (05058000)	250	125	39	50	<4,000
Valley City, ND (05058500)	273	125	41	50	<2,500
Lisbon, ND (05058700)	321	225	47	70	<2,250
Kindred, ND (05059000)	374	155	73	50	<2,800
West Fargo, ND (05059500)	379	100	75	50	None
Harwood, ND (05060400)	566	100	94	50	None
Red River of the North					
Wahpeton, ND (05051500)	927	450	328	100	None
Hickson, ND (05051522)	966	450	284	100	None
Fargo, ND (05054000)	1120	450	307	100	<3,000
Below Fargo, ND	1120	450	307	100	<3,000
Halstad, MN (05064500)	2760	1125	610	200	<15,000
Grand Forks, ND (05082500)	5388	2160	1354	440	<21,000
Drayton, ND (05092000)	6558	2610	1492	480	<14,000
Emerson, Manitoba, Canada (05102500)	7589	3060	1588	520	<26,000

[1]Mean Monthly Seasonal Flows for period of record used in the Phase I, Parts A and B, analysis (1931-1984); from Table 3.
[2]Aquatic Life Maintenance Seasonal Instream Flow Regime; Table 3 and Table 5. Riparian corridor maintenance flows would be met by the aquatic life maintenance seasonal instream flow regime and the natural riverine flow regime.
[3]Incorporating riverine riparian corridor improvement flows would require allowing non-damaging flood flows (U.S. Army Corps of Engineers, St. Paul District) to occur on an annual or semi-annual basis along both rivers. It is recommended that flows in excess of channel capacities (but less than maximum non-damaging flood flows above) be allowed between late May and early July to assist in pioneering species germination and growth. Flows which are out of channel (non-damaging channel capacity flows) should occur for a 2-week period between late May and early July preceding cottonwood and willow seed disbursal by approximately 1 week. This flow scheme should produce adequate moist soil conditions to benefit seed germination and growth and improve the existing flood plain forest community.
[4]USGS and/or International Gaging Station identification number.

If a goal of the management of the riverine riparian corridor is to improve the corridor for pioneering species (cottonwood-willow) seed germination and growth, large out-of-channel flows would be required (see Table 11). Non-damaging overbank flows in excess of channel capacities (but less than maximum non-damaging flood flows displayed in Table 11) should be allowed to assist in pioneering species germination and growth (e.g., Red River of the North at Fargo channel capacities are about 1,000 cfs, maximum non-damaging flood flows are 3,000 cfs, and, therefore, flows between 1,000 and 3,000 cfs would help improve the riparian community). The non-damaging out of channel flows along the Sheyenne River and the Red River of the North reported in Table 11 were determined by the U.S. Army Corps of Engineers (Daniel Reinartz, U.S. Army Corps of Engineers, St. Paul District, Personal Communication). Non-damaging flows which are out of channel should occur for a 2-week period during late May through early July and precede cottonwood and willow seed disbursal by approximately 1 week. In absence of these out-of-channel flows, the existing flood plain forest community would be continued.

Low Flow Period (July-February)

The low flow period is critical to the maintenance and evolution of geomorphic features along the river corridor - especially flood plains, stream bars, and nursery bars for fish.

Managing the rivers to meet the aquatic life maintenance seasonal instream flow regime would maintain a perennial stream throughout each representative river reach, however, the magnitude of the flows would vary between the upper and lower watersheds on the Sheyenne River (being greater in the upper watershed and less in the lower watershed) and generally be less than historic flows on the Red River of the North (see Table 11). The existing hydrograph would be somewhat flattened as well, but not as much as during the high flow period. It is expected, however, that the aquatic life maintenance seasonal instream flow regime should stabilize groundwater levels at their present levels, and, at the same time, provide adequate moist soil conditions for the riparian forest community. The aquatic life maintenance seasonal instream flow regime is anticipated to maintain the existing flood plain forest community in its present status.

Providing high flows during the summer months (after early July) in excess of the present 10-year return period flood favor channel incision and may cause excessive riparian zone physical adjustments. Therefore, high flows are not recommended for the low flow period for riverine riparian corridor improvement.

Recommendations

The conditions which were determined to be necessary to maintain the existing flood plain forest community in its present status are:

1. Maintain perennial streamflow at the aquatic life maintenance seasonal instream flow regime level (Table 5). This should ensure the availability of shallow groundwater for the roots of existing riparian vegetation. Historical perennial streamflows are as follows

(percent of time that water year type is DRY-AVERAGE-WET for the 1931-1984 period of record, by river): Sheyenne River = 41:31:28 and Red River of the North = 36:35:29.

2. Maintain a moist seedbed and shallow groundwater for rooted seedlings to help ensure adequate moisture is available for the establishment of pioneering species. This moisture is generally supplied by spring runoff and flooding (natural riverine flow regime). Stream diversions, excessive groundwater pumping, or streamflow regulation (provided by dams) can prevent the spring runoff moisture needed for seed sprouting and rooting within the flood plain. Stream diversions should be managed in a way so as not to lessen spring runoff conditions along the Sheyenne River and the Red River of the North.

3. Implement measures to allow for natural tree/shrub revegetation to occur on both the Sheyenne River and the Red River of the North. This would assist in maintaining the riparian corridors. Removal of tree seedlings by livestock grazing and trampling is probably one of the greatest threats to the riparian community.

4. Maintaining natural successional change appears to be the most prudent management option for riparian corridor maintenance even though there are areas where the riparian zone is fairly narrow to nonexistent. Artificial wholesale planting of riparian vegetation is not being recommended for the Sheyenne River and Red River of the North at this time. If riparian area encroachment should become more of a problem in the future, consideration should be given to riparian protection and reestablishment in problem areas.

The conditions which were determined to be necessary to **improve** the existing flood plain forest community by improving the pioneering species community (cottonwood-willow complex) and changing the plant dominance are:

1. Changing the hydrograph to lessen the number of DRY water year types on both the Sheyenne River and the Red River of the North would not appreciably, in and by itself, improve the riverine riparian corridor and species diversity. Water alone cannot maintain the system. Alluvial bar formation and lowering the rate of stage drawdown on the river after flood events might provide some positive benefits for improving the riverine riparian corridor; higher landscape diversity would result (i.e., reestablishment of the cottonwood-willow complex in a lower flood plain position). Alluvial bar formation would provide a seedbed for cottonwood-willow germination [(natural or manmade - e.g., mechanically formed or river training devices constructed - jetties, gabbions, etc.)]. Gradually lessening the rate of river stage drawdown after flood events would allow better seedling survival rates. In lieu of these items being implemented, areas of the existing riparian corridor could be selectively manipulated to improve species diversification and improve the riparian area vegetational complex (e.g., mechanically removing existing vegetation and establishing new and different vegetation).

2. Allowing non-damaging out-of-bank flows on an annual or semi-annual basis along both rivers would help improve the riparian flood plain forest community. If available, non-damaging overbank flows in excess of channel capacities (but less than maximum non-damaging flood flows) should be provided to assist in pioneering species germination and growth (e.g., Red River of the North at Fargo channel capacities are about 1,000 cfs, maximum non-damaging flood flows are estimated to be 3,000 cfs, and, therefore, flows between 1,000 and 3,000 cfs would help improve the riparian community). Non-damaging out of channel flows along the Sheyenne River and the Red River of the North have been determined by the U.S. Army Corps of Engineers (Daniel Reinartz, U.S. Army Corps of Engineers, St. Paul District, Personal Communication). Non-damaging flows which are out of channel should occur for a 2-week period during late May through early July and precede cottonwood and willow seed disbursal by approximately 1 week.

   This flow scheme should produce adequate moist soil conditions to benefit pioneering species seed germination and growth. This improvement recommendation is just that, a recommendation to improve the existing riparian corridors. In its absence, the aquatic life maintenance flows are expected to be sufficient to maintain the existing flood plain forest community.